

REMARKS

Claims 1-5 and 8 have been rejected under 35 USC 103(a) as being unpatentable over Fujino et al in view of Horowitz et al. Claims 6 and 7 have been rejected under 35 USC 103(a) as being unpatentable over Fujino et al in view of Horowitz et al and further in view of Kumta et al. Applicants respectfully traverse these grounds of rejection and urge reconsideration in light of the following comments.

The present invention is directed to a method for producing a cathode material for a lithium secondary cell. The present invention requires the steps of preparing a solution selected from the group consisting of an alkaline solution, a carbonate solution and a hydrogen carbonate solution, with either an oxide or a carbonate of a metal, as a major component of the cathode material for a lithium secondary cell, suspended therein, dripping an aqueous solution of a salt of another element into the solution, precipitating and bonding a compound of the other element on the surface of the oxide or carbonate of the metal, as a major component, preparing a mixture by mixing the oxide or the carbonate of the metal, as a major component, with the compound of the other element, precipitated and bonded thereon, with a lithium compound, and firing the mixture.

In the present invention there are four critical steps that have to be performed. The first step involves the preparation of a solution from an alkaline solution, a carbonate solution or a hydrogen carbonate solution, with the solution having an oxide or carbonate of a metal suspended therein. The second step requires the dripping of an aqueous solution of a salt of another element into the solution to precipitate and bond a compound of the other element on the oxide or carbonate of the metal. In the third step, the oxide or carbonate of the metal with the compound of the other element precipitated and bonded thereon is mixed with a lithium compound to form a mixture and, in the fourth step, the mixture is fired.

As pointed out previously, the instant invention is based on the discovery that when doping a cathode material or lithium secondary cell, if a doping method is adopted in which a compound of a doping element is first precipitated and bonded on the surface of a compound of a metal, as the major component of the cathode material for a lithium secondary cell, in powdery form, by the use of a chemical method and, subsequently, the compound of the metal having the doping element deposited thereon is mixed with a lithium compound and subsequently fired, a cathode material is produced which gives the lithium secondary cell excellent initial capacity, cycle characteristics and safety. The prior art cited by the Examiner does not disclose the presently claimed invention.

The Fujino et al reference discloses a manganese oxide having a calcium and/or magnesium content of 0.01 to 2.5 mol % based on the mols of manganese, a lithium manganese complex oxide using the manganese oxide and a cobalt-coated lithium manganese complex oxide. These compounds are disclosed as having a particularly high discharge capacity and being useful for the improvement of cycle characteristics of a secondary battery as an active material of a positive electrode for a secondary battery with a nonaqueous electrolyte.

In the outstanding Office Action, the Examiner states that Fujino et al discloses the steps of providing a manganese oxide, adding lithium ions to the manganese oxide, putting the lithium manganese complex oxide in an alkali solution and coating the particles with cobalt from cobalt sulfate and solution and drying the mixture. The Examiner further states that Fujino et al fails to disclose the process steps in the exact order required by the present claims and that it also fails to teach the firing of the dried mixture. However, this reference clearly does not disclose the claimed process.

In the present invention, an oxide or carbonate of a metal, as a major component, which can be subjected to size control in advance, is suspended in a solution and the compound of the other element is precipitated and bonded on

the surface of the particles. Due to the step of preparing a mixture by mixing the chemical compound, as a major component, with the compound of the other element, precipitated and bonded thereon, with a lithium compound and firing the mixture, a cathode material for a lithium secondary cell can be obtained which is doped with the other element and possesses a very high doping uniformity with a minimum non-uniformity and doping.

In contrast thereto, the Fujino et al reference discloses a process for preparing a cobalt-coated lithium manganese complex oxide which requires the steps of oxidizing lithium manganese complex oxide particles dispersed in an aqueous alkali solution and a cobalt compound at a temperature of from 20-100°C so that a cobalt oxide epitaxially grows on the lithium manganese complex oxide, and collecting the resulting oxide after filtration, washing and drying. In Fujino et al, the cobalt oxide is epitaxially grown on the surface of a lithium manganese complex oxide, which has already been prepared.

Fujino et al discloses that coating lithium manganese complex oxide with a cobalt oxide makes it possible to remarkably improve the cycle characteristics without causing a serious reduction of battery capacity. In the present invention, the lithium complex oxide is formed through the firing of the mixture of the chemical compound, as a major component, with the compound of the other element precipitated and bonded thereon, with a lithium compound. Fujino discloses the coating of the cobalt oxide on the formed lithium manganese complex oxide. This is clearly different from the present invention and the secondary references cited by the Examiner must provide the motivation to one of ordinary skill in the art to modify Fujino et al in a manner that would yield the presently claimed invention. It is respectfully submitted that the secondary references contain no such disclosure.

The Horowitz et al reference discloses the use of high surface area mixed metal oxides of manganese and calcium in

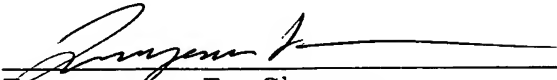
electrochemical processes. This reference has been cited by the Examiner as disclosing a firing process that removes impurities and mixed metal oxides. However, this reference contains no disclosure which would motivate one of ordinary skill in the art to modify the process of Fujino et al in a manner that would yield the presently claimed invention. Additionally, since the cobalt-coated lithium manganese oxide complex oxide prepared by the process disclosed in Fujino et al is a final product, firing this product would alter the characteristics thereof. Therefore, Horowitz et al actually teaches away from firing the product of Fujino et al and this combination of references clearly does not present a showing of prima facie obviousness under 35 USC 103(a).

The Kumta et al reference discloses cathode materials for lithium-ion secondary cells. This reference has been cited by the Examiner as teaching a lithium cobalt oxide doped with magnesium. However, this reference does not disclose the presently claimed method of obtaining the cathode material. Therefore, this reference in combination with the previously discussed references does not present a showing of prima facie obviousness under 35 USC 103(a).

As pointed out previously, objective evidence is of record in the present application which is more than sufficient to rebut any prima facie obviousness rejection under 35 USC 103(a). On pages 8-21 of the present specification, Examples and Comparative Examples are presented in which the Comparative Examples are closer to the presently claimed invention than the disclosures of the references cited by the Examiner. As shown by the results contained in Tables 1-7, the instant invention provides a cathode active material having unexpectedly superior properties as compared to the cathode active materials prepared by the comparative processes. This clearly establishes the patentability of the presently claimed invention over the prior art cited by the Examiner.

The Examiner is respectfully requested to reconsider the present application and to pass it to issue.

Respectfully submitted,


Terryence F. Chapman

TFC/smd

FLYNN, THIEL, BOUTELL
& TANIS, P.C.
2026 Rambling Road
Kalamazoo, MI 49008-1631
Phone: (269) 381-1156
Fax: (269) 381-5465

David G. Boutell
Terryence F. Chapman
Mark L. Maki
Liane L. Churney
John A. Waters
Brian R. Tumm
Donald J. Wallace
Stephen C. Holwerda
Dale H. Thiel
Sidney B. Williams, Jr.
Heon Jekal
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